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32074 7590 11/09/2009

INTERNATIONAL BUSINESS MACHINES CORPORATION
DEPT. 18G
BLDG. 321-482
2070 ROUTE 52
HOPEWELL JUNCTION, NY 12533

EXAMINER

HAMLIN, JR, KENNETH B

ART UNIT

PAPER NUMBER

2893

DATE MAILED: 11/09/2009

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/597,288

07/19/2006

Dureseti Chidambarao

FIS920030347US1

8869

TITLE OF INVENTION: VERTICAL FIN-FET MOS DEVICES

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	\$1510	\$300	\$0	\$1810	02/09/2010

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

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B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

**Complete and send this form, together with applicable fee(s), to: Mail Mail Stop ISSUE FEE
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INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

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32074 7590 11/09/2009

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I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/597,288 07/19/2006 Dureseti Chidambarao FIS920030347US1 8869

TITLE OF INVENTION: VERTICAL FIN-FET MOS DEVICES

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
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nonprovisional NO \$1510 \$300 \$0 \$1810 02/09/2010

EXAMINER	ART UNIT	CLASS-SUBCLASS
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HAMLIN, JR, KENNETH B 2893 257-347000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) the names of up to 3 registered patent attorneys or agents OR, alternatively, 1 _____

(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed. 2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

- ☐ Issue Fee
☐ Publication Fee (No small entity discount permitted)
☐ Advance Order - # of Copies _____

4b. Payment of Fee(s); (Please first reapply any previously paid issue fee shown above)

- ☐ A check is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27. ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____

Date _____

Typed or printed name _____

Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/597,288	07/19/2006	Dureseti Chidambarao	FIS920030347US1	8869
32074	7590	11/09/2009	EXAMINER	
INTERNATIONAL BUSINESS MACHINES CORPORATION DEPT. 18G BLDG. 321-482 2070 ROUTE 52 HOPEWELL JUNCTION, NY 12533			HAMLIN, JR, KENNETH B	
			ART UNIT	PAPER NUMBER
			2893	
			DATE MAILED: 11/09/2009	

Determination of Patent Term Extension under 35 U.S.C. 154 (b) (application filed after June 7, 1995 but prior to May 29, 2000)

The Patent Term Extension is 0 day(s). Any patent to issue from the above-identified application will include an indication of the 0 day extension on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Extension is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Notice of Allowability	Application No.	Applicant(s)	
	10/597,288	CHIDAMBARRAO ET AL.	
	Examiner	Art Unit	
	KENNETH HAMLIN	2893	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☐ This communication is responsive to ____.
2. ☒ The allowed claim(s) is/are 1-21.
3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some* c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).
* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
(a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
(b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

- | | |
|--|--|
| 1. <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 5. <input type="checkbox"/> Notice of Informal Patent Application |
| 2. <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 6. <input type="checkbox"/> Interview Summary (PTO-413),
Paper No./Mail Date _____. |
| 3. <input checked="" type="checkbox"/> Information Disclosure Statements (PTO/SB/08),
Paper No./Mail Date <u>20080428, 20060719</u> | 7. <input checked="" type="checkbox"/> Examiner's Amendment/Comment |
| 4. <input type="checkbox"/> Examiner's Comment Regarding Requirement for Deposit
of Biological Material | 8. <input checked="" type="checkbox"/> Examiner's Statement of Reasons for Allowance |
| | 9. <input type="checkbox"/> Other _____. |

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it **MUST** be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Dan Schnurman on 11/02/2009.

The application has been amended as follows:

Claim 2 has been canceled.

Replace Claim 1 with the following:

A vertical Fin-FET semiconductor device characterized by:

At least one vertical semiconductor fin (12A) disposed on an insulator layer (4);

Doped source (26A) and drain regions (28A) in bottom and top portions of the at least one semiconductor fin (12A); and

Gate conductors (24A, 24B) disposed along vertical sidewalls of the at least one semiconductor fin (12A) and separated therefrom by thin gate insulators (22).

Source conductors (18A, 18B) contacting the source region (26A) on opposite sides of the at least one semiconductor fin (12A);

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At least one source contact (38A) connecting to at least one source conductor (18A, 18B);

At least one drain contact (40A) connecting to the drain region (28A) of the at least one semiconductor fin (12A);

A vertical channel region in the fin (12A) between the source region (26A) and the drain region (28A); and

At least one gate contact (42A) connection to at least one gate conductor (24A, 24B).

Line 1, Claim 3 replace, "according to claim 2" with - according to claim 1 -.

Line 1, Claim 4 replace, "according to claim 2" with - according to claim 1 -.

Line 1, Claim 5 replace, "according to claim 2" with - according to claim 1 -.

Line 1, Claim 6 replace, "according to claim 2" with - according to claim 1 -.

Line 1, Claim 7 replace, "according to claim 2" with - according to claim 1 -.

Line 1, Claim 8 replace, "according to claim 2" with - according to claim 1 -.

Line 1, Claim 9 replace, "according to claim 2" with - according to claim 1 -.

Line 1, Claim 10 replace, "according to claim 2" with - according to claim 1 -.

Line 1, Claim 12 replace, "according to claim 2" with - according to claim 1 -.

Line 1, Claim 13 replace, "according to claim 2" with - according to claim 1 -.

Line 1, Claim 14 replace, "according to claim 2" with - according to claim 1 -.

Drawings

The drawings filed on 7/19/2006 and 4/20/2009 have been accepted.

Allowable Subject Matter

Claims 1-21 have been deemed as Allowable Subject Matter

The following is an examiner's statement of reasons for allowance:

Regarding Claims 1 and 15; the cited prior art of record does not teach or fairly suggest a vertical Fin-FET semiconductor device comprising, along with the other claimed features, source conductors contacting the source region on opposite sides of the at least one vertical fin; at least one source contact connecting to at least one source conductor; at least one drain contact connecting to the drain region of the at least one semiconductor fin; and at least one gate contact connecting to at least one gate conductor.

Regarding Claim 20; the cited prior art of record does not teach or fairly suggest a method of forming a vertical Fin-FET device comprising, along with the other claimed features, the step of forming metal source, drain and gate contacts by Damascene processes of selective etching, metal fill, and chem-mech polishing.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Relevant Cited Prior Art

Fitch et al. (US 5,414,289) discloses a vertical Fin-FET semiconductor device characterized by at least one vertical semiconductor fin disposed on an insulator layer. Doped source and drain regions in bottom and top portions of the at least one semiconductor fin; and gate conductors disposed along vertical sidewalls of the at least one semiconductor fin and separated therefrom by thin gate insulators; and a vertical channel region in the fin between the source region and the drain region.

Fitch et al. fails to disclose source conductors contacting the source region on opposite sides of the at least one semiconductor fin; At least one source contact connecting to at least one source conductor; at least one drain contact connecting to the drain region of the at least one semiconductor fin; at least one gate contact connecting to at least one gate conductor.

Noble et al. (US 6,238,976) discloses a vertical Fin-FET semiconductor device characterized by at least one vertical semiconductor fin disposed on an insulator layer. Doped source and drain regions in bottom and top portions of the at least one semiconductor fin; and gate conductors disposed along vertical sidewalls of the at least one semiconductor fin and separated therefrom by thin gate insulators; and a vertical channel region in the fin between the source region and the drain region.

Noble et al. does not disclose source conductors contacting the source region on opposite sides of the at least one semiconductor fin; At least one source contact connecting to at least one source conductor; at least one drain contact connecting to the

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drain region of the at least one semiconductor fin; at least one gate contact connecting to at least one gate conductor.

Rudeck (US 6,680,508) discloses a vertical Fin-FET with source and drain regions in the bottom and top portions of the at least one semiconductor fin; with a bit line contacting the drain region.

Rudeck does not disclose source conductors contacting the source region on opposite sides of the at least one semiconductor fin; At least one source contact connecting to at least one source conductor

Huang et al. (IEEE transactions on electron devices) discloses a vertical P-Channel FinFET with gate electrodes formed on both sides of a semiconductor fin.

Huang et al. does not disclose source conductors contacting the source region on opposite sides of the at least one semiconductor fin; At least one source contact connecting to at least one source conductor; at least one drain contact connecting to the drain region of the at least one semiconductor fin; at least one gate contact connecting to at least one gate conductor.

It would not be obvious to modify any of the cited prior art, because none of the prior art discloses a means of connecting a contact to both the source and drain regions of a vertical FinFET, while including a gate contact connected to the gate conductor.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to KENNETH HAMLIN whose telephone number is (571)270-3341. The examiner can normally be reached on Mon - Fri 9am - 5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Davienne Monbleau can be reached on 571-272-1945. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/K. H./
Examiner, Art Unit 2893

/Davienne Monbleau/
Supervisory Patent Examiner, Art Unit 2893